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INVESTIGATION OF SOIL CONTAMINATION BY PAH, PCB AND TRACE METALS IN THE VICINITY OF MARKET LANE PUBLIC SCHOOL TORONTO 1990

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INTRODUCTION

Through the latter half of the last century and the first half of this century, Consumer's Gas Company operated a coal gasification facility in the Front Street East and Parliament Street area of Toronto. This facility produced gaseous hydrocarbons from coal. A by-product of this process is coal tar; which contains polycylic aromatic hydrocarbons (PAH). The Toronto Public Library Service Centre now occupies at least part of this historic gas works site. Prior to construction of the centre, extensive decommissioning of the site was performed and special building design features were utilized to reduce the possibility of exposure to these coal tar products (Bajc et al, 1988).

Other properties in this area have also been examined for the presence of coal tar products. These investigations usually preceded any redevelopment activities of the properties. One of these properties is known as 54 Parliament Street and is located to the southwest of the library centre property. This property is to be developed for residential use. An environmental consulting firm investigated this property for PAH contamination. PAH compounds were detected throughout the property, both in surface fill and deeper native soil. Liquid coal tar was also located in one area (TDM, 1988).

In July of 1990, the Ministry of the Environment, Central Region, requested a surface soil investigation by the Phytotoxicology Section, Air Resources Branch, of the property immediately south of 54 Parliament Street. This property was being used as an annex for Market Lane Public School, and contained several temporary classroom buildings. The request cited PAH, polychlorinated biphenyls (PCB) and trace metals as potential contaminants of the property.

Immediately upon discovery of PAH contamination on the school annex property by the Ministry, and disclosure of this information to the Toronto Board of Education, the Board acted to isolate the contamination. A heavy cloth membrane was placed over all accessible soil surfaces on the property and covered with a layer of crushed limestone (screenings). This work was completed in early September, 1990, just prior to the start of the school year.

Subsequent to the initial request and investigation, various other properties were investigated as a result of specific requests from citizens and institutions. This report also summarizes data for samples collected as a result of such requests.

SAMPLING LOCATIONS AND PROCEDURES

A total of 46 sites were sampled between July 24, 1990 and October 30, 1990. Table 1 summarizes the location of these sites, describes the nature and depth of the samples, and identifies the analyses performed. This table also lists the geographic coordinates for these sites using the Modified Transverse Mercator (MTM) grid system. The MTM system is used on the City of Toronto Property Data Maps, which were used as base maps for positioning the sampling sites. The precision with which the sampling coordinates are identified is ±10 metres.

The maps in the attached figure illustrate the locations of all sampling sites within the various properties. The map base for the figure was generated from the above-mentioned Property Data Maps.

Samples were collected with a chrome-plated, steel soil corer. This device extracts a two centimetre diameter "plug" from the soil. The collection of soil samples at each site involved compositing 12 cores of soil from various parts of the site into a polyethylene bag. Subsequently, six more cores were composited into special solvent-washed glass jars. The former were destined for trace metal analyses, and the latter for organic (PAH, PCB) analyses. By collecting the inorganic samples first, any residual organic contaminants from the previous site that have adhered to the soil corer would be removed. Where samples for inorganic analysis were not collected, the corer was washed with a soap solution then rinsed with deionized water and acetone before the sample was collected.

At sites where the material was not soil, but coarse sand or finely crushed limestone (screenings), the corer was used to scoop the surface material into the respective containers.

SAMPLE PROCESSING AND ANALYSIS

Samples destined for trace metal analyses were processed in the Phytotoxicology processing laboratory. This involved air drying the sample and then passing it through a 2 mm sieve to remove stones and coarse debris. An aliquot of this homogenized and screened material was ground with an agate mortar and pestle to

pass through a 355 um sieve. The processed samples were delivered to the Laboratory Services Branch (LSB), Inorganic Trace Contaminants Section, for analysis for trace metals. The fifteen elements included in the tests are indicated in Table 2.

Samples destined for PAH and PCB analyses were delivered in an unprocessed and field-moist condition to the LSB Trace Organics Section.

Details of the analytical methodologies can be obtained from the LSB.

ANALYTICAL RESULTS

The results of the trace metals analyses are summarized in Table 2. Metal analyses were not performed on samples collected at some sites. These data are contrasted with the Phytotoxicology Upper Limit of Normal (ULN) guidelines for urban soil. The ULN's are based on a review of analytical data for background soil samples collected in urban environments. The ULN value is the mean concentration of these samples plus three standard deviations. Thus, the ULN represents the highest concentration that might be expected in an urban soil that is not influenced by a point source of pollution (see attached appendix). The ULN guidelines were exceeded at four sample sites (Cr at Sites 29, 30 and 31, and Cu at Site 45).

The results of the PAH analyses are summarized in Table 3. There were 16 PAH compounds analyzed. These are identified at the top of the table and cross-referenced to the data column labels (A through P). Interim guidelines for PAH concentrations in soil were adopted by the Canadian Council of Ministers of the Environment (CCME, 1989). The interim guidelines are available for nine of 16 PAH compounds and the "B" levels (to be discussed below) are reproduced at the bottom of the table. PAH concentrations that exceed these guidelines are highlighted.

The results of the PCB analyses are not tabulated. With one exception, all concentrations were below the detection limit of 20 nanograms per gram. The exception was Site 10, which had a concentration of 630 nanograms per gram.

DISCUSSION

Prior to any interpretation or discussion of the results of this investigation, it is important to emphasize that these samples consisted, in most cases, of the top five centimetres of material presently at the surface. It cannot be assumed that this material is indigenous to a particular site; in fact this entire area is land that has been reclaimed from Lake Ontario by decades of lakefilling. There is a high probability that many of the sites were landscaped using soil imported from other locations. Course sand and screenings were clearly imported. Also, soil presently at the surface may have originated in the general vicinity, but from greater depths. Building construction would significantly perturbate soil stratification.

Table 2 shows that, at 38 of the 42 sites for which data are available, trace metal concentrations were below the urban ULN guidelines. This indicates that there is no evidence of soil metal contamination at these sites. However, it is noteworthy that three sites (29, 30 and 31) had chromium concentrations that marginally exceeded the ULN. These three sites were from the same area, Crombie Park C (see Figure 1). It is apparent that soil from this area is not indigenous.

Site 45 is another site that is distinct. Soil from this site was collected within 10 metres of the St. James Cathedral building. This is a historic building in Toronto, and therefore the grounds are not likely to have been disturbed. While copper was the only metal that exceeded the ULN, soil at this site also had the highest lead, arsenic, and selenium concentrations, and the second highest zinc and antimony concentrations.

Possible causes for the marginal elevation of several metals at this site include decades of rain leaching copper from the roof and eavestroughs into the ground adjacent to the building; as well as the extended time that soil at this site has been undisturbed and exposed to general urban pollution sources.

Table 3 highlights several sites where PAH concentrations exceeded the CCME "B" level interim guidelines. The CCME document provides recommendations on the application of the interim guidelines. For sites that are intended for residential or farming use, the "B" level is the remedial criteria. Where concentrations exceed the "B" level

"... action is required to reduce exposure for humans or other biota. Action could include cleanup, other mitigation and/or change in land use." (CCME, 1989)

For the purpose of applying the guideline, it is reasonable to expand the "residential and farming" category to include school and recreational properties.

The sites where the "B" guidelines were exceeded were concentrated on the Market Lane Public School annex property. Two other sites that also exceeded the guidelines were located on either side of the annex. Site 13 was immediately across Hahn Place, in Crombie Park A. Site 24 was across Parliament Street and within 100 metres of the school annex property. Although Site 24 appeared to be part of the library property, it was actually a small green space fronting a parking lot. During the construction of the library service centre, the land was decommissioned. The decommissioning may not have extended to the area of this sample site.

The only other site where a PAH guideline was exceeded was Site 45, near the St. James Cathedral building. This was the same site that had elevated trace metal concentrations. Since low levels of PAH compounds are ubiquitous in an urban environment, the presence of PAH at this site could be due to the same mechanism proposed for the metals; long-term exposure to atmospheric deposition and accumulation in soil. Since the cathedral is approximately one kilometre from the library building (the location of the gas works), the presence of PAH's is probably unrelated to the gas works.

The ubiquitous nature of low levels of PAH compounds in Toronto soil was demonstrated in a survey conducted for the City of Toronto Housing Department. This survey involved surface soil sampling at 30 sites, in five distinct areas of the city. Concentrations of PAH compounds ranged from non-detectable to slightly less than one microgram per gram (SENES, 1991). However, CCME "B" guidelines were not exceeded in any samples.

Apart from the school annex area and cathedral site where PAH concentrations exceeded the "B" guideline, most of the remaining sites had less than detectable concentrations. Sample sites that contained detectable but less than "B" guideline concentrations included Sites 22 and 23 on the southern portion of the library property; and Sites 36 and 37 in the park adjacent to

the cathedral. However, PAH concentrations at these sites were within the background range encountered in the City of Toronto Housing Department study conducted by SENES.

The failure to detect PAH compounds at many of the sites in this survey probably reflects the widespread use of soil imported from rural areas that have not been exposed to the "normal" degree of contamination associated with long term exposure in an urban environment. The evidence collected in this survey, and in the City of Toronto sponsored background survey, suggests that surface soil in Toronto can contain PAH compounds at concentrations approaching one microgram per gram.

Another sample deserves discussion. This is the sample of limestone screenings collected at Site 35, within the school annex property. PAH compounds were detected in this sample up to but not exceeding the CCME "B" guideline. It is possible that these screenings became contaminated through contact with underlying contaminated soil.

The absence of detectable concentrations of PCB's at all but one site further illustrates the likelihood that most of the soil sampled in this survey was imported from non-urban areas. Previous Phytotoxicology soil surveys in Toronto and other major municipalities indicated that measurable PCB's were present in about 20% of urban surface soil samples in areas with no known current or historic PCB source. The source of the 630 nanogram per gram PCB concentration at Site 10 is not known. In another CCME interim guideline document (CCME, 1987) for PCB's in soil, the recommended maximum acceptable concentration for residential or general public access areas is 5000 nanograms per gram. The concentration encountered at Site 10 is an order of magnitude lower than the CCME interim guideline, and is within the upper range of PCB concentrations in urban soil not affected by a local PCB source.

CONCLUSIONS

This investigation identified the presence of PAH compounds in surface soil in the vicinity of Market Lane Public School. Almost all of the sites that contained PAH concentrations that exceeded the CCME "B" interim guidelines were located on the school annex or immediately adjacent properties. Contamination of this area by the historic gas works is indicated. Many other sites had detectable concentrations below these guidelines, com-

parable to normal urban background levels. The remaining sites did not have detectable PAH compounds, reflecting landscaping soil imported from rural areas.

Most sites had concentrations of trace metals that were well within normal background concentrations for urban soil. Marginal soil contamination by chromium at three sites and by copper at one site was not associated with the historic gasification plant.

PCB concentrations were below detection limits at all but one site. At this site, the concentration was an order of magnitude below the CCME interim guideline.

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SENES Consultants Limited, *Soil Sampling Program for Determination of Background Levels of PAH's in Toronto Soils*, Report to the Corporation of the City of Toronto, February, 1991

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TABLE 1: Summary and Location of Samples Collected in the Vicinity of Market Lane Public School

Site No.	Date Sampled	Sample Description and Depth	Analyses Performed	Site Location / Cover	3' MTM Easting	3' MTM Northing
1	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 890	4 834 250
2	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 900	4 834 220
3	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 910	4 834 210
4a	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 890	4 834 210
4b	14/09/90	Screenings 0-2 cm	PAH PCB	Market Lane P. S. Annex / New Screenings	315 890	4 834 210
5	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 860	4 834 200
6	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 840	4 834 190
7	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 830	4 834 190
8	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 820	4 834 200
9	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 820	4 834 210
10	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 820	4 834 230
11	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 830	4 834 230
12	24/07/90	Soil 0-5 cm	PAH PCB Metals	Market Lane P. S. Annex / Grass	315 880	4 834 230
13	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park A / Grass	315 790	4 834 200
14	06/09/90	Screenings 0-2 cm	PAH PCB Metals	Crombie Park A / Screenings	315 770	4 834 200
15	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park A / Grass	315 730	4 834 190
16	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park A / Grass	315 670	4 834 160
17	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park A / Grass	315 640	4 834 150
18	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park A / Grass	315 610	4 834 140
19	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park B / Grass	315 580	4 834 130
20	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park B / Grass	315 550	4 834 120
21	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park B / Grass	315 510	4 834 110
22	06/09/90	Soil 0-5 cm	PAH PCB Metals	South of library / Grass	315 910	4 834 350
23	06/09/90	Soil 0-5 cm	PAH PCB Metals	South of library / Grass	315 890	4 834 360
24	06/09/90	Soil 0-5 cm	PAH PCB Metals	South of library / Grass	315 900	4 834 330
25	06/09/90	Soil 0-2 cm	PAH PCB Metals	Day care centre / Grass/Bare	315 620	4 834 010
26	06/09/90	Coarse sand 0-2 cm	PAH PCB Metals	Day care centre / Coarse sand	315 610	4 834 000
27	06/09/90	Soil 0-5 cm	PAH PCB Metals	Apartment lawn / Grass	315 610	4 834 020
28	06/09/90	Soil 0-5 cm	PAH PCB Metals	Co-op courtyard / Grass	315 890	4 834 130
29	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park C / Grass	315 480	4 834 080
30	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park C / Grass	315 450	4 834 090
31	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park C / Grass	315 420	4 834 090
32	06/09/90	Soil 0-5 cm	PAH PCB Metals	Crombie Park D / Grass	315 350	4 834 060
33	14/09/90	Screenings 0-2 cm	PAH PCB	Crombie Park E / Screenings	315 290	4 834 030
34	14/09/90	Screenings 0-2 cm	PAH PCB	Crombie Park E / Screenings	315 260	4 834 010
35	14/09/90	Buried screenings	PAH PCB	Market Lane P. S. Annex / Old Screenings	315 850	4 834 220
36	14/09/90	Soil 0-5 cm	PAH PCB Metals	St. James Park / Grass	315 030	4 834.380
37	14/09/90	Soil 0-5 cm	PAH PCB Metals	St. James Park / Grass	315 050	4 834 340
38	30/10/90	Soil 0-15 cm	PAH PCB Metals	Library / NW Flower Bed	315 900	4 834 410
39	30/10/90	Soil 0-5 cm	PAH PCB Metals	Library / NW Grass	315 890	4 834 410
40	30/10/90	Soil 0-5 cm	PAH PCB Metals	Library / N Grass	315 900	4 834 420
41	30/10/90	Soil 0-5 cm	PAH PCB Metals	Library / NE Grass	315 950	4 834 420
42	30/10/90	Soil 0-15 cm	PAH PCB Metals	Library / Austrian Pine Bed	315 920	4 834 380
43	30/10/90	Soil 0-15 cm	PAH PCB Metals	Library / Wood Chips	315 910	4 834 370
44	30/10/90	Soil 0-15 cm	PAH PCB Metals	Library / SW Flower Bed	315 900	4 834 380
45	30/10/90	Soil 0-5 cm	PAH PCB Metals	St. James Park / Grass	314 960	4 834 320
46	30/10/90	Coarse Sand 0-2 cm	PAH PCB	St. James Park / Coarse sand	314 960	4 834 330

4a and 4b represent samples collected at Site 4 on different dates.

TABLE 2: Soil Trace Metal Concentrations in the Vicinity of Market Lane Public School - ug/g dry weight

Site No	Cu	Ni	Pb	Zn	Mn	As	Cd	Co	Cr	Mo	Na	Sb	Se	Sr	V
1	32	15	60	120	430	2.5	0.75	11.0	19	0.6 <T	150	0.79 <T	0.61 <T	28	31
2	29	15	62	380	400	2.0	1.70	10.0	19	0.2 <W	170	0.79 <T	0.41 <T	31	31
3	18	13	31	97	410	1.8	0.58	10.0	17	0.8 <T	150	0.46 <T	0.35 <T	26	30
4a	17	13	29	63	440	1.9	0.45	9.7	18	0.2 <W	160	0.46 <T	0.41 <T	24	28
4b not analyzed															
5	26	16	26	110	480	2.0	0.51	11.0	21	0.7 <T	210	0.29 <T	0.68 <T	32	35
6	43	16	59	110	470	2.2	0.49	11.0	21	0.2 <W	210	0.29 <T	0.80 <T	41	33
7	29	17	62	100	460	3.5	0.99	11.0	23	0.2 <W	180	1.40	0.54 <T	42	35
8	26	18	41	100	450	2.3	1.10	11.0	24	0.7 <T	210	0.21 <T	0.34 <T	39	36
9	23	16	40	86	400	2.3	0.87	10.0	21	0.2 <W	200	0.37 <T	0.47 <T	32	33
10	19	16	23	69	480	2.8	0.87	12.0	23	0.2 <W	220	0.30 <T	0.81 <T	31	37
11	21	15	33	71	400	2.2	1.00	11.0	21	0.2 <W	200	0.72 <T	0.67 <T	25	36
12	27	13	52	89	350	1.9	0.84	8.8	16	0.2 <W	160	0.89 <T	0.41 <T	30	27
13	39	20	56	130	430	3.8	1.30	11.0	24	0.2 <W	190	0.63 <T	0.75 <T	57	34
14	24	12	38	110	470	6.8	0.64	2.5	12	0.2 <T	220	0.97 <T	0.20 <W	61	14
15	31	16	44	85	420	2.2	1.20	9.4	24	0.2 <W	190	0.37 <T	0.55 <T	36	34
16	34	16	26	75	440	2.0	1.20	9.3	23	0.2 <W	210	0.38 <T	0.49 <T	42	35
17	26	18	28	71	440	2.2	1.10	10.0	24	0.4 <T	210	0.20 <W	0.55 <T	34	36
18	26	14	42	60	270	2.8	0.97	6.8	16	0.2 <W	210	0.47 <T	0.62 <T	68	26
19	32	21	29	82	600	2.6	1.30	12.0	29	0.7 <T	220	0.20 <W	0.75 <T	42	41
20	56	22	26	81	560	2.1	1.50	12.0	34	0.8 <T	220	0.29 <T	0.96 <T	32	44
21	36	22	36	88	600	2.8	1.50	14.0	32	0.2 <W	210	0.30 <T	0.83 <T	36	44
22	35	19	85	87	390	3.3	1.30	10.0	24	0.6 <T	200	0.38 <T	0.82 <T	51	35
23	35	18	120	110	400	2.9	1.50	9.8	22	0.3 <T	190	4.30	0.89 <T	57	29
24	43	21	130	140	420	3.1	1.50	11.0	26	1.1	210	1.40	0.59 <T	45	34
25	21	12	10 <T	43	310	1.9	0.70	7.9	18	0.2 <W	330	0.20 <W	0.49 <T	36	31
26	11	9.1	5 <T	22 <T	170	1.5	0.63	4.6	9	0.6 <T	130	0.20 <W	0.20 <W	140	24
27	24	14	31	58	290	2.7	0.87	8.7	19	0.6 <T	200	0.50 <T	0.56 <T	44	29
28	23	15	24	67	310	1.9	1.00	8.5	20	0.4 <T	160	0.31 <T	0.64 <T	23	29
29	60	17	45	97	420	2.7	1.30	11.0	55	0.5 <T	170	0.49 <T	0.83 <T	41	34
30	29	19	34	81	470	2.7	1.10	12.0	69	0.8 <T	200	0.59 <T	0.63 <T	32	39
31	33	19	36	79	450	2.5	1.30	12.0	53	0.6 <T	170	0.31 <T	0.85 <T	31	36
32	24	14	30	61	420	2.3	1.10	8.4	20	0.4 <T	150	0.22 <T	0.59 <T	21	31
33 not analyzed															
34 not analyzed															
35 not analyzed															
36	32	17	110	100	290	3.2	0.21 <T	4.8	21	0.2 <W	190	0.61 <T	0.93 <T	43	35
37	16	15	27	53	370	2.8	0.05 <W	5.5	22	0.2 <W	180	0.26 <T	0.74 <T	30	35
38	25	14	16	52	460	2.3	0.33	5.9	19	0.2 <W	140	0.26 <T	0.54 <T	28	32
39	22	13	18	54	410	3.5	0.43	5.9	19	0.2 <W	170	0.49 <T	0.44 <T	33	32
40	37	14	44	82	420	2.3	0.38	5.9	22	0.2 <W	180	0.60 <T	0.52 <T	46	32
41	28	16	20	64	420	2.3	0.45	6.9	24	0.2 <W	220	0.60 <T	0.51 <T	47	36
42	20	14	10 <T	51	450	1.6	0.25 <T	6.5	23	0.3 <T	190	0.27 <T	0.44 <T	27	37
43	28	14	11	54	480	2.2	0.51	6.7	22	0.8 <T	160	0.39 <T	0.43 <T	29	36
44	27	21	14	72	600	3.4	0.36	9.8	31	0.2 <W	220	0.40 <T	0.59 <T	42	47
45	270	18	200	200	280	9.7	1.10	5.9	31	0.2 <W	240	2.50	2.00	46	37
46 not analyzed															
ULN	100	60	500	500	700	20	4	25	50	3	n/a	8	2	n/a	70

ULN = Upper Limit of Normal Guideline for urban soil (see attached appendix) n/a = not available = concentration > ULN

<T = The reported value is a tentative or trace amount. <W = A measured result of 'zero'.

TABLE 3: Soil Polycyclic Aromatic Hydrocarbon Concentrations in the Vicinity of Market Lane Public School - ug/g dry weight

A = Naphthalene	E = Phenanthrene	I = Benzo[a]anthracene	M = Benzo[a]pyrene
B = Acenaphthylene	F = Anthracene	J = Chrysene	N = Indeno[1,2,3-cd]pyrene
C = Acenaphthene	G = Fluoranthene	K = Benzo[b]fluoranthene	O = Dibenzo[ah]anthracene
D = Fluorene	H = Pyrene	L = Benzo[k]fluoranthene	P = Benzo[ghi]perylene

Site No	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	0.14 <T	0.13 <T	0.18 <T	0.20 <T	2.10	0.41	3.80	3.30	1.20	1.70	2.00	0.84	1.90	2.10	0.51	1.80
2	0.45	0.50	0.25 <T	0.33 <T	2.90	1.10	5.50	4.90	2.10	2.80	2.50	1.20	3.30	3.30	0.72	3.10
3	0.07 <T	0.14 <T	0.06 <T	0.05 <T	0.47 <T	0.13	1.30	1.40	0.55	0.70	0.97	0.42	1.20	1.10	0.22 <T	1.10
4a	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.27 <T	0.06 <T	0.52	0.49 <T	0.23	0.30	0.42 <T	0.18 <T	0.46	0.48	0.10 <T	0.40 <T
4b	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.02 <W	0.06 <W	0.02 <W	0.02 <W	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
5	0.12 <T	0.11 <T	0.07 <T	0.07 <T	0.57 <T	0.13	1.20	1.10	0.48	0.64	0.99	0.42	1.10	1.20	0.29 <T	1.10
6	0.04 <W	0.06 <T	0.04 <W	0.04 <T	0.28 <T	0.38	0.54	0.45 <T	0.21	0.29	0.36 <T	0.15 <T	0.37 <T	0.44	0.09 <T	0.34 <T
7	0.55	0.13 <T	0.08 <T	0.12 <T	1.40	0.30	2.80	2.40	0.98	1.30	1.50	0.61	1.40	1.40	0.32 <T	1.10
8	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.33 <T	0.06 <T	0.58	0.48 <T	0.22	0.30	0.38 <T	0.16 <T	0.35 <T	0.37 <T	0.07 <T	0.29 <T
9	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.19 <T	0.03 <T	0.29	0.23 <T	0.09 <T	0.13 <T	0.15 <T	0.08 <T	0.16 <T	0.18 <T	0.04 <W	0.15 <T
10	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.07 <T	0.06 <W	0.02 <T	0.04 <T	0.06 <W	0.03 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
11	0.04 <W	0.05 <W	0.07 <T	0.09 <T	1.00	0.19	1.50	1.10	0.48	0.65	0.75	0.33	0.70	0.71	0.15 <T	0.50
12	0.11 <T	0.10 <T	0.19 <T	0.26 <T	2.80	0.56	4.50	3.60	1.70	2.10	2.10	0.96	2.20	2.00	0.40 <T	1.70
13	0.04 <W	0.05 <W	0.04 <W	0.20 <T	0.07 <W	0.44	3.98	3.84	1.90	1.96	3.30	2.32	2.86	3.28	0.76	0.24 <T
14	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.60	0.50 <T	0.04 <T	0.04 <T	0.06 <W	0.04 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
15	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.10 <T	0.03 <T	0.20	0.20 <T	0.09 <T	0.1 <T	0.10 <T	0.10 <T	0.1 <T	0.09 <T	0.04 <W	0.08 <T
16	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.04 <W	0.01 <W	0.08 <T	0.06 <T	0.05 <T	0.04 <T	0.06 <W	0.05 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
17	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.20 <T	0.02 <T	0.20	0.20 <T	0.07 <T	0.08 <T	0.09 <T	0.07 <T	0.06 <T	0.07 <T	0.04 <W	0.60 <T
18	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.05 <T	0.06 <W	0.04 <T	0.03 <T	0.06 <W	0.05 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
19	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.20 <T	0.20 <T	0.07 <T	0.08	0.08 <T	0.08 <T	0.06 <T	0.09 <T	0.04 <W	0.08 <T
20	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.04 <T	0.06 <W	0.04 <T	0.04	0.06 <W	0.04 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
21	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.08 <T	0.01 <W	0.20 <T	0.20 <T	0.08 <T	0.10	0.10 <T	0.10 <T	0.08 <T	0.10 <T	0.04 <W	0.09 <T
22	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.50 <T	0.10 <T	0.80	0.70	0.30	0.30	0.40 <T	0.30	0.30 <T	0.30 <T	0.06 <T	0.20 <T
23	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.60 <T	0.10 <T	1.10	0.90	0.40	0.50	0.60 <T	0.40	0.40 <T	0.50	0.09 <T	0.40 <T
24	0.20 <T	0.05 <W	0.40 <T	0.50	5.20	1.80	5.50	4.30	2.30	2.20	2.50	2.20	2.60	2.50	0.50	1.50

TABLE 3: (con't) Soil Polycyclic Aromatic Hydrocarbon Concentrations in the Vicinity of Market Lane Public School - ug/g dry weight

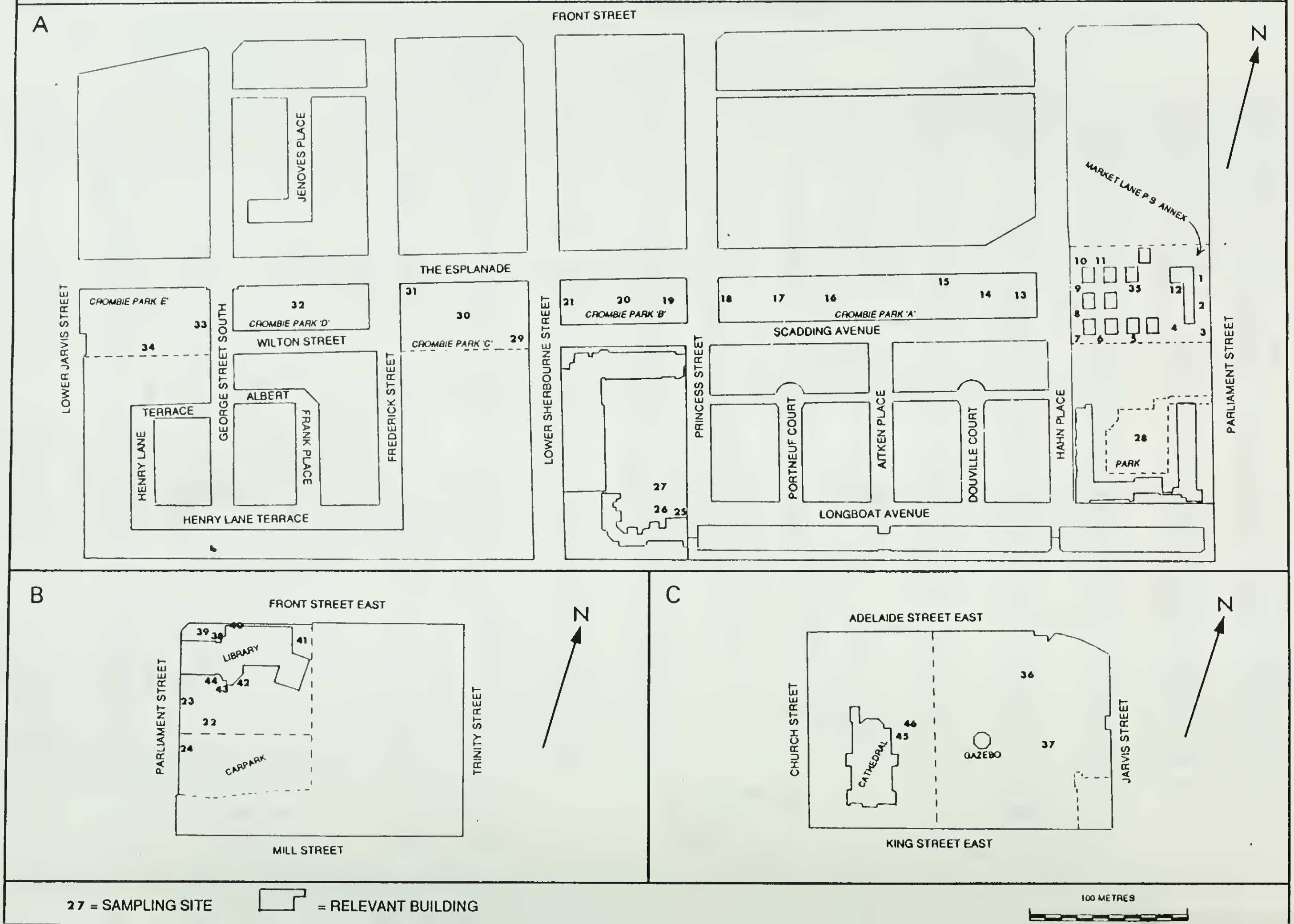
A = Naphthalene	E = Phenanthrene	I = Benzo[a]anthracene	M = Benzo[a]pyrene
B = Acenaphthylene	F = Anthracene	J = Chrysene	N = Indeno[1,2,3-cd]pyrene
C = Acenaphthene	G = Fluoranthene	K = Benzo[b]fluoranthene	O = Dibenzo[ah]anthracene
D = Fluorene	H = Pyrene	L = Benzo[k]fluoranthene	P = Benzo[ghi]perylene

Site No	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
25	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.02 <W	0.06 <W	0.03 <T	0.02 <W	0.06 <W	0.06 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
26	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.02 <W	0.06 <W	0.03 <T	0.02 <W	0.06 <W	0.03 <T	0.04 <W	0.04 <W	0.04 <W	0.04 <W
27	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.10 <T	0.02 <T	0.02 <T	0.20 <T	0.10 <T	0.10 <T	0.10 <T	0.10 <T	0.07 <T	0.10 <T	0.04 <W	0.06 <T
28	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.10 <T	0.09 <T	0.06 <T	0.06 <T	0.08 <T	0.08 <T	0.04 <T	0.06 <T	0.04 <W	0.04 <W
29	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.10 <T	0.02 <T	0.02 <T	0.20 <T	0.08 <T	0.08 <T	0.1 <T	0.08 <T	0.05 <T	0.07 <T	0.04 <W	0.06 <T
30	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.10 <T	0.02 <T	0.20 <T	0.20 <T	0.08 <T	0.09 <T	0.1 <T	0.09 <T	0.06 <T	0.08 <T	0.04 <W	0.06 <T
31	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.08 <T	0.06 <T	0.04 <T	0.04 <T	0.06 <W	0.05 <T	0.04 <T	0.04 <T	0.04 <W	0.04 <W
32	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.10 <T	0.10 <T	0.06 <T	0.07 <T	0.09 <T	0.08 <T	0.05 <T	0.07 <T	0.04 <W	0.06 <T
33	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.03 <T	0.06 <W	0.02 <W	0.02 <T	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
34	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.04 <T	0.06 <W	0.02 <W	0.02 <T	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
35	0.04 <W	0.05 <W	0.10 <T	0.11 <T	1.40	0.29	2.30	1.70	1.00	0.84	1.00	0.41	0.79	0.61	0.10 <T	0.45
36	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.50 <T	0.09 <T	0.70	0.64	0.36	0.34	0.46 <T	0.19 <T	0.37 <T	0.37 <T	0.08 <T	0.29 <T
37	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.22 <T	0.04 <T	0.34	0.29 <T	0.16 <T	0.16 <T	0.26 <T	0.11 <T	0.22 <T	0.18 <T	0.04 <W	0.13 <T
38	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.03 <T	0.06 <W	0.02 <W	0.02 <W	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
39	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.02 <W	0.06 <W	0.02 <W	0.02 <W	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
40	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.02 <W	0.06 <W	0.02 <W	0.02 <W	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
41	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.05 <T	0.06 <W	0.03 <T	0.03 <T	0.06 <W	0.02 <W	0.04 <W	0.05 <T	0.04 <W	0.04 <W
42	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.05 <T	0.06 <W	0.03 <T	0.03 <T	0.06 <W	0.03 <T	0.04 <W	0.10 <T	0.04 <W	0.04 <W
43	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.07 <T	0.06 <W	0.03 <T	0.03 <T	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
44	0.05 <T	0.05 <W	0.04 <W	0.04 <W	0.09 <T	0.02 <T	0.16 <T	0.12 <T	0.08 <T	0.07 <T	0.14 <T	0.07 <T	0.11 <T	0.30 <T	0.04 <W	0.08 <T
45	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.50 <T	0.08 <T	0.75	0.64	0.36	0.34	0.54 <T	0.29	0.38 <T	1.80	0.08 <T	0.22 <T
46	0.04 <W	0.05 <W	0.04 <W	0.04 <W	0.07 <W	0.01 <W	0.03 <T	0.06 <W	0.02 <W	0.02 <W	0.06 <W	0.02 <W	0.04 <W	0.04 <W	0.04 <W	0.04 <W
CCME B	5	n/a	n/a	n/a	5	n/a	n/a	10	1	n/a	1	1	1	1	1	n/a

CCME B = Canadian Council of Ministers of the Environment 'B' Value Interim Guideline. See text for explanation. n/a = not available = concentration > CCME B

<T = The reported value is a tentative or trace amount. <W = A measured result of 'zero'.

FIGURE: LOCATION OF SOIL SAMPLING SITES



Appendix

Derivation and Significance of the MOE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a point source of pollution. Urban ULN guidelines are based on samples collected from developed urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (ref: Ontario Ministry of the Environment 1983, *Phytotoxicology Field Investigation Manual*). Chemical analyses were conducted by the MOE Laboratory Services Branch.

The ULN is the arithmetic mean, plus three standard deviations of the mean, of the suitable background data. This represents 99% of the sample population. This means that for every 100 samples which have not been exposed to a point source of pollution, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.